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Document Name: API 12F: Specification for Shop Welded Tanks for Storage of Production Liquids

CFR Section(s): 49 CFR 195.264(b)(1)

Standards Body: American Petroleum Institute

APPROVED

Official Incorporator:

THE EXECUTIVE DIRECTOR
OFFICE OF THE FEDERAL REGISTER
WASHINGTON, D.C.

Specification for Shop Welded Tanks for Storage of Production Liquids

API SPECIFICATION 12F
ELEVENTH EDITION, NOVEMBER 1, 1994

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Specification for Shop Welded Tanks for Storage of Production Liquids

Exploration and Production Department

API SPECIFICATION 12F
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American
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Date of Issue: February 2007
Affected Publication: API Specification 12F, *Specification for Shop Welded Tanks for Storage of Production Liquids*, Eleventh Edition, November 1, 1994

ERRATA

Page 2, **Section 2.9,** *change:*
"Tank bolting ½ inch in diameter to and including **½ inch** in length shall..."
to
"Tank bolting ½ inch in diameter to and including **1 – ½ inch** in length shall..."

CONTENTS

		Page
1	SCOPE	1
	1.1 General	1
	1.2 Compliance	1
2	MATERIAL	1
	2.1 General	1
	2.2 Plates	1
	2.3 Sheets	1
	2.4 Welding Electrodes	1
	2.5 Structural Shapes	1
	2.6 Piping	1
	2.7 Flanges	1
	2.8 Couplings	1
	2.9 Bolting	2
3	DESIGN	2
	3.1 General	2
	3.2 Definitions	2
	3.3 Size of Weld	2
	3.4 Joint Restrictions	2
	3.5 Size	2
	3.6 Type	2
	3.7 Thickness	2
	3.8 Joints in Bottom Plates	2
	3.9 Shell Attachments	2
	3.10 Thickness	5
	3.11 Shell Joints	5
	3.12 Type	5
	3.13 Thickness	5
	3.14 Deck Joints	5
	3.15 Shell Attachment	5
	3.16 Cleanout	5
	3.17 Connections	5
	3.18 Anti-Channel Drain Baffle	5
	3.19 Downcomer Pipe	5
4	VENTING REQUIREMENTS	6
	4.1 Normal Venting	6
	4.2 Emergency Venting	6
5	FABRICATION, TESTING, AND PAINTING	7
	5.1 Fabrication	7
	5.2 Welding	7
	5.3 Testing	7
	5.4 External Painting	7
	5.5 Internal Coating	7
6	MARKINGS	7
	6.1	7
	6.2	7
7	INSPECTION AND REJECTION	7
	7.1 Inspection Notice	7

7.2 Inspection 7
7.3 Rejection 8

APPENDIX A—SPECIFICATION FOR TANK BOLTING 9
APPENDIX B—RECOMMENDED PRACTICE FOR NORMAL VENTING 11
APPENDIX C—RECOMMENDED RELIEVING CAPACITIES 13
APPENDIX D—WALKWAYS, STAIRWAYS AND LADDERS 15
APPENDIX E—SUGGESTIONS FOR ORDERING 17
APPENDIX F—USE OF API MONOGRAM 19

Figures
1—Tank Dimensions 4
2—Type A (Unskirted) Cone Bottom 5
3—Type B (Skirted) Cone Bottom 5
4—24-In. x 36-In. Extended-Neck Cleanout 6
5—Suggested Name Plate Format 8
F-1—Suggested Name Plate Format 21

Tables
1—Tank Dimensions 3
B-1—Venting Capacity Requirements 11
C-1—Emergency Venting Requirements 13
C-2—Calculated Venting Capacity of 8-Inch Round Thief Hatch 14

FOREWORD

This specification is under the jurisdiction of the API Committee on Standardization of Production Equipment.

This specification is based on the accumulated knowledge and experience of purchasers and manufacturers of shop welded steel storage tanks of various sizes and capacities for internal pressures approaching atmospheric. The object of this publication is to provide a purchase specification to facilitate the manufacture and procurement of storage tanks for production service, such as storage of crude oil, condensate, hydrocarbon products and nonpotable water. If tanks are purchased in accordance with these specifications, the purchaser is expected to specify certain basic requirements.

This standard shall become effective on the date printed on the cover but may be used voluntarily from the date of distribution.

Specification for Shop Welded Tanks for Storage of Production Liquids

1 Scope

1.1 GENERAL

a. This specification covers material, design, fabrication, and testing requirements for shop-fabricated vertical, cylindrical, aboveground, closed top, welded steel storage tanks in various standard sizes and capacities for internal pressures approximately atmospheric, not to exceed those listed in Column 2, Table 1.

b. This specification is designed to provide the oil production industry with tanks of adequate safety and reasonable economy for use in the storage of crude petroleum and other liquids commonly handled and stored by the production segment of the industry. This specification is for the convenience of purchasers and manufacturers in ordering and fabricating tanks.

1.2 COMPLIANCE

The manufacturer is responsible for complying with all of the provisions of this specification. The purchaser may make any investigation necessary to satisfy himself of compliance by the manufacturer and may reject any material that does not comply with this specification. It is urged that the purchaser avail himself of this right and furnish his own inspection independently of any supervisory inspection furnished by the manufacturer, and that the purchaser's inspector follow closely all the details of shop fabrication and/or field construction and testing herein specified which affect the integrity and safety of the completed structure.

2 Material

2.1 GENERAL

Materials listed in this section have been selected to provide adequate strength and reasonable service life. Other materials having mechanical properties equal to or greater than these listed may be used by agreement between the purchaser and the manufacturer. Where higher strength materials are used, the minimum thicknesses called for in this specification shall not be reduced.

2.2 PLATES

a. Plates shall conform to the latest edition of the following ASTM Standards*:

A 36 *Structural Steel*

A 283 *Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality*—grade C or D.

A 285 *Low and Intermediate Tensile Strength Carbon Steel Plates for Pressure Vessels*—Grade C.

b. Shell plates for which minimum thicknesses have been fixed for practical reasons (greater than required by computation) and which will not underrun the required computed thickness by more than 0.01 in., as well as all roof and bottom plates, may be purchased on a weight basis. The plate thicknesses or weights, as stipulated herein, are minimums; thicker or heavier material may be required on the order at the option of the purchaser.

2.3 SHEETS

Sheets shall conform to the latest revision of ASTM A 570, grade C or D, open-hearth process and basic oxygen process. Sheets may be ordered on a weight or thickness basis, at the option of the tank manufacturer.

2.4 WELDING ELECTRODES

Manual arc-welding electrodes shall conform to the E 60 and E 70 Series of Classification (suitable for the electric current characteristics, the position of welding, and other conditions of intended use) in the latest edition of AWS** A-5.1 *Specification for Mild Steel Arc-Welding Electrodes.*

2.5 STRUCTURAL SHAPES

Structural shapes shall be of open-hearth, electric-furnace, or basic oxygen process and shall conform to the latest edition of ASTM A 36.

2.6 PIPING

Pipe shall conform to Grade A or B of the latest edition of API Specification 5L; ASTM A 53; or ASTM A-106.

2.7 FLANGES

Hub slip-on welding and welding-neck flanges shall conform to the material requirements for forged carbon steel flanges as specified in ANSI B16.5.†

2.8 COUPLINGS

Couplings for threaded connections may be supplied with or without recess, complying with the dimensional, physical and chemical requirements of the latest edition of API Specification 5L, Grade B. Alternatively, couplings may comply with the latest edition of ANSI B16.11† for Steel Pipe Couplings.

*Available from American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pa. 19103.

**Available from American Welding Society (AWS) P.O. Box 351040, Miami, Florida 33135.

†American National Standards Institute (ANSI), 1430 Broadway, New York, N.Y. 10018.

2.9 BOLTING

Tank bolting 1/2 inch in diameter to and including 1/2 inch in length shall conform to the requirements given in Appendix A. All other bolting shall conform to the latest revision of ASTM A-307, Grade A or B. Unless otherwise specified on the purchase order, black-finish bolts and nuts shall be furnished. When specified to be galvanized, bolts and nuts shall be zinc-coated in accordance with Appendix A or the applicable ASTM Specification. Alternative materials and/or finish conforming to recognized standards for bolting may be furnished by agreement between the purchaser and the manufacturer.

3 Design

3.1 GENERAL

Tanks covered by this specification have been designed using established engineering calculations to determine minimum metal thickness and bolting specifications for each size tank filled with water (62.37 lb/cu.ft @ 60F) and at the internal pressure specified in column 2, Table 1. In order to assure structural stability and integrity, additional metal thickness has been added to that determined by calculation. The minimum metal thickness specified in this standard shall in no case be decreased.

JOINT DESIGN

3.2 DEFINITIONS

The following definitions shall apply to tank-joint designs.

3.2.1 double-welded butt joint: A joint between two abutting parts lying in approximately the same plane and welded from both sides. A joint with filler metal added from one side only is considered equivalent to a double-welded butt joint when means are provided for accomplishing complete penetration and reinforcement on both sides of joint.

3.2.2 double-welded lap joint: A joint between two overlapping members, in which the overlapped edges of both members are welded with fillet welds.

3.2.3 butt weld: A weld placed in a groove between abutting members. Grooves may be square, V (single or double) or U (single or double).

3.2.4 fillet weld: A weld of approximately triangular cross-section joining two surfaces approximately at right angles to each other, as in a lap joint, tee joint, or corner joint.

3.2.5 full-fillet weld: A fillet weld whose size is equal to the thickness of the thinner member joined.

3.2.6 tack weld: A weld made to hold parts of a weldment in proper alignment until the final welds are made.

3.3 SIZE OF WELD

The size of a weld shall be based on the following dimensions:

a. Groove-Weld. The joint penetration (depth of chamfering plus the root penetration when specified).
b. Fillet Weld. For equal leg fillet welds, the leg length of the largest isosceles right-triangle which can be inscribed within the fillet-weld cross-section. For unequal leg fillet welds, the leg lengths of the largest right-triangle which can be inscribed within the fillet-weld cross-section.

3.4 JOINT RESTRICTIONS

The following restrictions on type and size of joints or welds shall apply.

a. Tack welds shall not be considered as having any strength value in the finished structure.
b. The minimum size of fillet welds shall be as follows: Plate 3/16 in. in thickness, full-fillet welds; plates over 3/16 in. thick, not less than one-third the thickness of the thinner plate at the joint, with a minimum of 3/16 in.
c. Single-welded joints shall not be permissible on tank bottoms, shells, or decks.

3.5 SIZE

Tanks under this specification shall be furnished in the sizes and dimensions as stipulated in Table 1, columns 1 through 7, and Fig. 1, as specified on the purchase order.

BOTTOM DESIGN

3.6 TYPE

The tank bottom shall be flat, or of the type A (unskirted) or type B (skirted) cone design, as specified on the purchase order. Type A and type B cone bottoms shall conform to Fig. 2 and 3 respectively.

3.7 THICKNESS

The thickness of bottom plates shall be 1/4 in. (10.20 lb. per sq. ft.) nominal, except the sump of the type A cone bottom which shall be 3/8 in. (15.30 lb. per sq. ft.) nominal.

3.8 JOINTS IN BOTTOM PLATES

Bottom joints shall be double-welded butt joints with complete penetration.

3.9 SHELL ATTACHMENTS

The tank bottom shall be attached to the tank shell, if the bottom is flanged, by a double-welded butt joint with complete penetration, or by a double-welded, full-fillet lap joint; or, if the bottom is not flanged, by full-fillet welds, both inside and outside.

Table 1—Tank Dimensions (See Fig. 1)

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nominal Capacity, bbl.	Design Pressure oz. per sq. in.		Approximate Working Capacity, bbl. (See Note)	Outside Diameter, ft. in. *A*	Height, ft. *B*	Height of Overflow Connection*, ft. in. *C*	Height of Walkway Lugs, ft. in. *D*	Location of Fill-Line Connection,* in. *E*	Size of Connections, in. C-1, C-2, C-3, C-7	Size of Connections, in. C-4, C-5, C-6
	Press.	Vacuum								
90	16	1/2	72	7 - 11	10	9 - 6	7 - 7	14	3	3
100	16	1/2	79	9 - 6	8	7 - 6	5 - 7	14	3	3
150	16	1/2	129	9 - 6	12	11 - 6	9 - 7	14	3	3
200	16	1/2	166	12 - 0	10	9 - 6	7 - 7	14	3	4
210	16	1/2	200	10 - 0	15	14 - 6	12 - 7	14	3	4
250	16	1/2	224	11 - 0	15	14 - 6	12 - 7	14	4	4
300	16	1/2	266	12 - 0	15	14 - 6	12 - 7	14	4	4
400	16	1/2	366	12 - 0	20	19 - 6	17 - 7	14	4	4
500	16	1/2	466	12 - 0	25	24 - 6	22 - 7	14	4	4
500	8	1/2	479	15 - 6	16	15 - 6	13 - 7	14	4	4
750	8	1/2	746	15 - 6	24	23 - 6	21 - 7	14	4	4
Tolerance (all sizes)				±1/8 in.	±3/8 in.	±1/8 in.	±1/8 in.	±1/8 in.		

Note: The approximate working capacities shown in Col. 3 apply to flat-bottom tanks.

Type A (unskirted) cone-bottom tanks have 6 in. more working height than the corresponding flat-bottom tanks. The approximate increase is 4 bbl. for the 7-ft. 11-in. diameter tanks, 6 bbl. for the 9-ft. 6-in. diameter tanks, 7 bbl. for the 10-ft. diameter tanks, 8 bbl. for the 11-ft. diameter tanks, 10 bbl. for the 12-ft. diameter tanks, and 17 bbl. for the 15-ft. 6-in. diameter tanks.

Type B (skirted) cone-bottom tanks have 8 in. less working height than the corresponding flat-bottom tanks. The approximate decrease in capacity is 6 bbl. for the 7-ft. 11-in. diameter tanks, 8 bbl. for the 9-ft. 6-in. diameter tanks, 9 bbl. for the 10-ft. diameter tanks, 11 bbl. for the 11-ft. diameter tanks, 13 bbl. for the 12-ft. diameter tanks, and 15 bbl. for the 15-ft. 6-in. diameter tanks.

*Viscous Oil Option. When so specified on the purchaser order, tanks shall be furnished for viscous oil service. On such tanks, dimension *C* of the overflow-line connections shall be 6 in. less than shown in Col. 6, Table 1 and dimension *E* of the fill-line connection shall be 6 in., ±1/8 in.

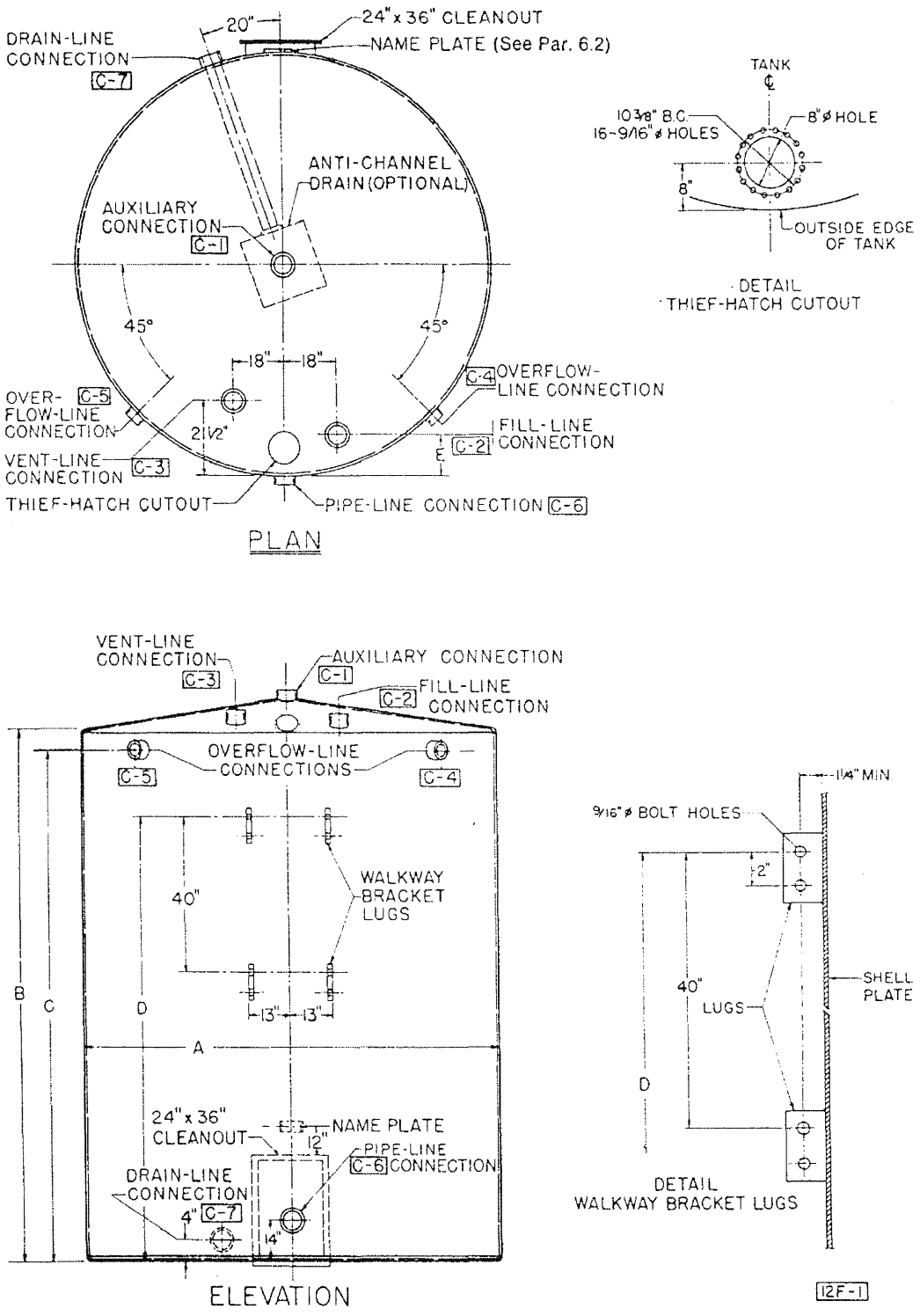

Figure 1—Tank Dimensions—See Table 1

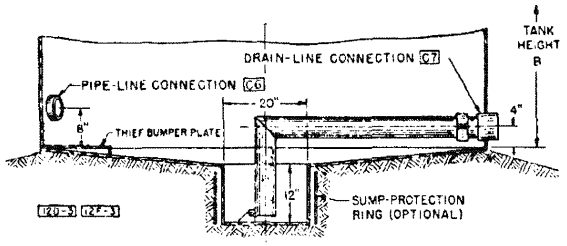

Figure 2—Type A (Unskirted) Cone Bottom

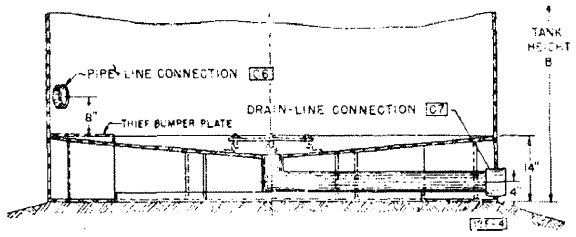

Figure 3—Type B (Skirted) Cone Bottom

SHELL DESIGN

3.10 THICKNESS

The thickness of shell plates shall be either $^3/_{16}$ in. (7.65 lb. per sq. ft.) nominal, or $^1/_4$ in. (10.20 lb. per sq. ft.) nominal, as specified on the purchase order. The width of shell plates shall be determined by the manufacturer, but preferably should be not less than 60 in.

3.11 SHELL JOINTS

Shell-plate joints shall be double-welded butt joints with complete penetration.

DECK DESIGN

3.12 TYPE

The deck shall be of the self-supporting, cone type, with a slope of 1 in. in 12 in.

3.13 THICKNESS

The thickness of deck plates shall be the same as the thickness of the shell plates, except that for 15 ft.-6 in. diameter tanks the deck shall be $^1/_4$ in. nominal unless added structural supports in the form of rafters are provided.

3.14 DECK JOINTS

Deck plate joints shall be double-welded butt joints with complete penetration.

3.15 SHELL ATTACHMENT

The tank deck shall be attached to the tank shell, if the deck if flanged, by a double-welded butt joint with complete penetration, or by a double-welded, full-fillet lap joint; or, if the deck is not flanged, by full-fillet welds, both inside and outside.

APPURTENANCE DESIGNS

3.16 CLEANOUT

Tanks shall be furnished with a 24-in. x 36-in. extended-neck cleanout, located as shown in Fig.1 and conforming to Fig. 4. Cleanout cover plates shall be of one-piece construction, except that, if so specified on the purchase order they shall be of two-piece construction with a horizontal lap seam having one row of $^1/_2$-in. bolts on 2-in. centers with suitable gaskets and bolt retainers. If two-piece construction is specified, the top inspection plate shall have a clear opening of approximately 14 in. by 24 in., unless otherwise specified. When specified on the purchase order, handles for lifting the cleanout cover plate(s) shall be furnished.

3.17 CONNECTIONS

Tanks may be provided with inlet and outlet connections as shown in Table 1, Columns 9 and 10, and Fig. 1. Unless otherwise specified by the purchaser, connections shall be full couplings, and shall be attached to the tank member by full-fillet welds on both inside and outside surfaces, with equal projections inside and outside the tank, except that half couplings may be used for connections C-1, C-4, C-5, and C-6, at the option of the manufacturer. Additional or fewer connections of other sizes or locations may be provided, if so agreed between the purchaser and the manufacturer. When flanged or other types of connections are specified, the nozzle neck shall be a minimum of standard weight pipe and attached by full-fillet welds, both inside and outside. The bolting pattern for the thief hatch shall conform to Fig. 1.

3.18 ANTI-CHANNEL DRAIN BAFFLE

An anti-channel drain baffle conforming to the following requirements shall be furnished if so specified on the purchase order.

a. The periphery of the baffle, in plan view, shall be 64 in.
b. The height of the baffle from the inside surface of the tank bottom to the top of the baffle shall be 4 in. minimum for 90-bbl. tanks, and $5^1/_4$ in. minimum for all other sizes.
c. The baffle shall be equipped with spacers so that the bottom edge of the baffle is 1 in. above the tank bottom.
d. A drain line shall be provided from the baffle to the tank shell. The line size shall be 3 in. nominal for 90-bbl. tanks and 4 in. nominal for all other sizes.
e. The baffle shall be attached to the tank bottom by a J-bolt passing through an eye retainer welded to the tank bottom, and by the line connection to the tank shell. The baffle shall not be welded to the tank bottom.

3.19 DOWNCOMER PIPE

A downcomer pipe shall be installed if requested by the purchaser; design of downcomer to be by agreement between purchaser and manufacturer.

4 Venting Requirements

4.1 NORMAL VENTING

Connections C-1 and C-3 are provided for normal inbreathing and outbreathing due to temperature changes and to liquid movement into and out of the tank. These connections should be fitted with pressure-vacuum valves properly sized in accordance with API Standard 2000. The pressure setting should be from 2 to 4 ounces/sq. in. less than the opening pressure of devices used for emergency venting. Appendix B is provided as a guide to aid in the selection of venting devices, where required.

4.2 EMERGENCY VENTING

When storage tanks containing flammable liquids are exposed to fire, the venting rate may be in excess of that resulting from a combination of normal thermal effects and oil movement. Unless tanks are installed in remote locations, the purchaser shall provide, or cause to be provided, pressure relieving devices which will provide capacity in addition to normal venting to meet the requirements tabulated in Table

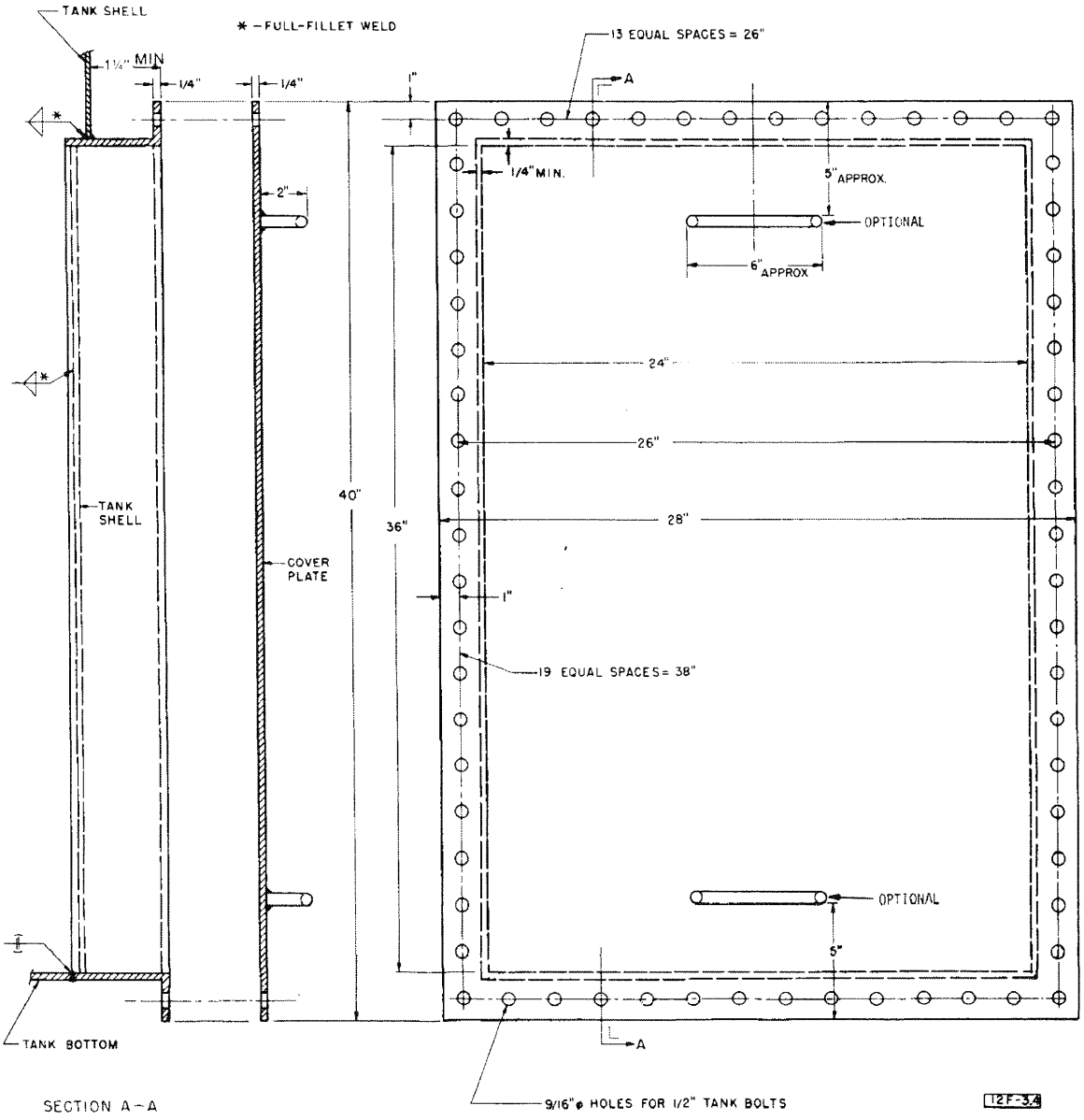

Figure 4—24-In. x 36-In. Extended-Neck Cleanout (See 3.16)

C.1. The opening pressure of such devices shall not exceed the design pressure of the tank on which the devices are installed. The maximum internal pressure under relieving conditions should not exceed that tabulated in column 6 of Table C.1. Pressure relieving devices may take the form of larger or additional vent valves or additional thief hatches.

Note: *With drainage* as used in column 5, Table C.1, means that flammable or combustible liquids will not be retained near the tank by dykes or firewalls.

5 Fabrication, Testing, and Painting

5.1 FABRICATION

Fabrication shall be completed in the shop of the manufacturer in accordance with the best modern practices.

5.2 WELDING

Welding procedures shall be established and welding operators qualified by the manufacturer. Qualification of welders in accordance with the applicable parts of the latest edition of Section IX of the ASME Boiler and Pressure Vessel Code[1] is recommended.

5.3 TESTING

Tanks shall be tested in the shop of the manufacturer by the following method:

a. Brace bottom by securely attaching external stiffening member if required to eliminate permanent deformation during test.
b. Close all openings with plugs or covers as needed. Bolts and gaskets of the size and type required for final installation are to be used during test.
c. The tank will be tested with air to 1½ times the maximum design pressure of the tank. (See 3.1).
CAUTION: When testing with air, adequate valves, regulators, and pressure relief devices shall be used to prevent overpressure or permanent deformation.
d. For the detection of leaks, apply soap suds, linseed oil, or other suitable material to all shell, bottom, roof, and attachment welds. Carefully examine for leaks.
e. All defects found in welds by leak test shall be repaired by the manufacturer, and the tank retested.
f. After release of air pressure, bottom stiffening, if used, shall be removed and scars repaired.

5.4 EXTERNAL PAINTING

Before shipment, tanks shall be cleaned of rust, grease, scale, and weld spatter, and coated with a good grade of commercial metal primer, unless specified to be unpainted by the purchaser. Finish coats or other protective coatings shall be applied if so agreed upon between the purchaser and the manufacturer.

5.5 INTERNAL COATING

Where internal coating is required, procedures and methods outlined in NACE[2] Standard RP-03-72, *Method for Lining Lease Production Tanks with Coal Tar Epoxy* are recommended as a minimum requirement. Other coatings and methods may be used by agreement between purchaser and manufacturer.

6 Markings[3]

6.1 Tanks manufactured in conformance with this specification shall be identified by a name plate bearing the information shown in Fig. 5.

6.2 The name plate shall be stamped, etched or embossed on corrosion-resistant material and permanently attached to a bracket or backing plate of ferrous material. Alternatively, name plate information may be die stamped on a steel plate. The bracket, backing plate or name plate shall be seal-welded to the tank shell in the location shown in Fig. 1.

7 Inspection and Rejection

7.1 INSPECTION NOTICE

Where the inspector representing the purchaser desires to inspect tanks purchased or witness any specified tests, reasonable notice shall be given of the time at which such inspection should be made.

7.2 INSPECTION

The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which will concern the manufacture of the material ordered. The manufacturer shall afford, without charge, all reasonable facilities to satisfy the inspector that the material is being manufactured in accordance with this specification. All inspections should be made at the place of manufacture prior to shipment, unless otherwise specified on the purchase order; and shall be so conducted as not to interfere unnecessarily with the manufacturer's operations.

[1]The American Society of Mechanical Engineers, 345 E. 47th Street, New York, NY 10017.

[2]National Association of Corrosion Engineers, P.O. Box 218340, Houston, Texas 77218.

[3]Users of this specification should note that there is no longer a requirement for marking a product with the API monogram. The American Petroleum Institute continues to license use of the monogram on products covered by this specification but it is administered by the staff of the Institute separately from the specification. The policy describing licensing and use of the monogram is contained in Appendix F, herein. No other use of the monogram is permitted.

7.3 REJECTION

Material which shows injurious defects on initial inspection or subsequent to acceptance at manufacturer's works, or which proves defective when properly applied in service, may be rejected, and the manufacturer so notified. If tess that require the destruction of material are made at other than the place of manufacture, the purchaser shall pay for material complying with all of the provisions of this specification, but shall not pay for any material which fails to meet the specification.

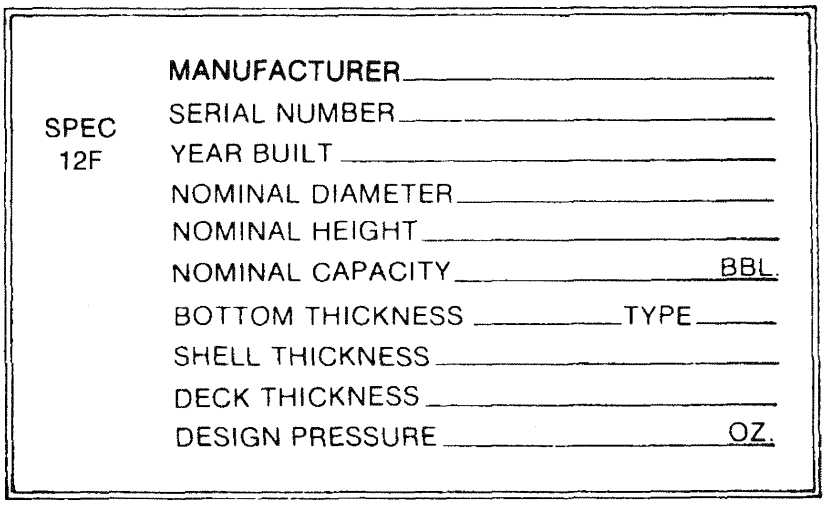

Figure 5—Suggested Name Plate Format

APPENDIX A—SPECIFICATION FOR TANK BOLTING

A.1 Scope

The Appendix covers tank bolting 1/2 inch in diameter to and including 1 1/2 inch in length. Bolts and nuts shall be either black-finish or galvanized, as specified on the purchase order.

A.2 Physical Properties

The breaking load of the bolts, tested in full size, shall not be less than 11,350 lb.

Note: The breaking load of 11,350 lb. is equivalent to a tensile strength of 80,000 lb. per sq. in. based on the stress area (mean thread area) or approximately 91,000 lb. per sq. in. based on the root thread area.

A.3 Tension Test

Tension tests of bolts shall be taken on the finished bolt with the load applied between the head and a nut or suitable fixture, either of which will have sufficient thread engagement to develop the full strength of the bolt. The nut or fixture shall be assembled on the bolt leaving at least three full bolt threads exposed within the grip. If failure occurs by threads stripping before reaching the minimum required tensile load, the individual test shall be discarded.

A.4 Stripping Test

The nuts for bolts shall be capable of developing the load specified in Par. A.2 without stripping.

A.5 Head Test

During the tension test specified in A.3, failure shall occur in the threaded section and not at the junction of the head and shank.

A.6 Number of Tests

The requirements of these specifications are those met in continuous production for stock during which the manufacturer has made such sample inspections as to insure normally that the material is controlled within the specified limits. For this reason, additional tests by the manufacturer of the individual shipments of material are not contemplated. If specified on order, one tension test shall be made from each lot. A lot shall consist of 5000 pieces of fraction thereof.

A.7 Retests

Should the sample from the lot fail to meet the requirements of a specified test, two additional samples shall be tested; in which case, both samples shall meet the test.

A.8

Threads of unplated product shall be coarse-thread series as specified for screw threads (ANSI B1.1 of latest issue) having a class 2A tolerance for bolts and class 2B tolerance for nuts. Bolts to be galvanized shall have Class 2A threads before hot dip or mechanical galvanizing. After galvanizing, the maximum limit of pitch and major diameter may exceed the Class 2A limit by 0.021 inches.

A.9

Bolts shall be regular square, unless otherwise agreed upon between the purchaser and the manufacturer, in which case they may be regular hex. All bolts shall comply with the applicable section of the latest edition of ANSI B18.2.1., Square and Hex Bolts and Screws.

A.10

Nuts shall be regular square, unless otherwise agreed upon between the purchaser and the manufacturer, in which case they may be regular hex. All nuts shall comply with the applicable section of the latest edition of ANSI B18.2.2., Square and Hex Nuts.

A.11 Galvanizing

Unless otherwise specified, galvanized bolts and nuts shall be hot-dip galvanized in accordance with the requirements of Specification A 153. The weight of coating shall be that specified for Class C materials in Specification A 153 and the nuts shall be tapped after galvanizing. When specified by the purchaser to be mechanically galvanized, bolts and nuts shall be mechanically zinc-coated, and the coating shall conform to the requirements for Class 50 of Specification B 454 or to the coating thickness, adherence, and quality requirements for Class C of Specification A 153. Mechanically zinc-coated nuts for assembly with mechanically zinc-coated bolts shall be tapped oversize prior to coating and need not be retapped afterwards.

A.12 Marking

Bolt heads shall be marked (by raised or depressed mark at the option of the manufacturer) to identify the manufacturer. The manufacturer may use additional marking for his own use.

APPENDIX B—RECOMMENDED PRACTICE FOR NORMAL VENTING

Table B-1—Venting Capacity Requirements (See 4.1)

(1)	(2)		(3)		(4)	(5)	(6)	(7)
						Thermal Venting, SCFH		
							Pressure (Outbreathing)	
Nominal Tank Capacity, bbl	Tank Size Diameter ft.-in.	Tank Size Height ft.	Design Pressure oz. per sq. in. Press.	Design Pressure oz. per sq. in. Vac.	Surface Area, sq. ft.	Vacuum (Inbreathing) All Stocks	Flash Point 100 F or Above	Flash Point Below 100 F
90	7 - 11	10	16	1/2	250	90	55	90
100	9 - 6	8	16	1/2	240	100	60	100
150	9 - 6	12	16	1/2	360	150	90	150
200	12 - 0	10	16	1/2	378	200	120	200
210	10 - 0	15	16	1/2	372	210	125	210
250	11 - 0	15	16	1/2	520	250	150	250
300	12 - 0	15	16	1/2	565	300	180	300
400	12 - 0	20	16	1/2	755	400	240	400
500	12 - 0	25	16	1/2	945	500	300	500
500	15 - 6	16	8	1/2	780	500	300	500
750	15 - 6	24	8	1/2	1,170	750	450	750

Notes:

1. Filling and Emptying Venting.

a. Outbreathing at maximum filling rate: For flash points less than 100F, provide 1200 standard cubic feet per hour (SCFH) for each 100 bbl per hour. For flash points of 100F or more, provide 600 SCFH for each 100 bbl per hour.

b. Inbreathing at maximum emptying rate: For all liquids, provide 600 SCFH for each 100 bbl per hour.

2. The values calculated for filling and emptying venting requirements shall be added to the appropriate thermal venting requirements.

APPENDIX C—RECOMMENDED RELIEVING CAPACITIES

Table C-1—Emergency Venting Requirements (See Par. 4.2)

(1)	(2)	(3)		(4)	(5)		(6)
Nominal Capacity, bbl	Diameter x Height, ft-in.	Design Pressure, Ounces		Exposed Area, sq. ft.	Emergency Venting Required SCFH		Max. Press. During Emergency Venting, Ounces
		Pressure	Vacuum		With Drainage*	Without Drainage	
90	7-11 x 10-0	16	1/2	250	119,500	239,000	48
100	9-6 x 8-0	16	1/2	240	116,500	233,000	48
150	9-6 x 12-0	16	1/2	360	146,000	292,000	48
200	12-0 x 10-0	16	1/2	378	150,700	301,000	24
210	10-0 x 15-0	16	1/2	372	171,100	342,000	48
250	11-0 x 15-0	16	1/2	520	180,000	361,000	24
300	12-0 x 15-0	16	1/2	565	189,350	378,700	24
400	12-0 x 20-0	16	1/2	755	223,350	446,350	24
500	12-0 x 25-0	16	1/2	945	253,000	507,000	24
500	15-6 x 16-0	8	1/2	780	227,600	455,200	12
750	15-6 x 24-0	8	1/2	1,170	271,800	543,600	12

Note: Normal vents (4.1 and Appendix B) may satisfy all or part of these requirements.

*In applying recommended emergency venting required *with drainage* careful attention should be given to the provisions of 2.3.2 and 2.5.7, NFPA No. 30, available from National Fire Protection Association, Inc., Batterymarch Park, Quincy, MA 02269.

Table C-2—Calculated Venting Capacity of 8-Inch Round Thief Hatch

(1)	(2)	(3)	(4)
Venting Pressure, ounces	Venting Capacity, SCFH Q	Venting Pressure, ounces	Venting Capacity, SCFH Q
1.5	59,783	18	207,097
3.0	84,547	24	239,135
4.5	103,548	32	386,000
6.0	119,567	40	434,000
12.0	169,094	48	471,000

Note: Values in the above table are based on the following formula:

$$Q = 1667\, C_f A \sqrt{P_t - P_a}$$

Where:

Q = Venting capacity in standard cubic feet of free air per hour (SCFH)
C_f = 0.5 [the flow coefficient]
A = Hatch area, sq. in. (A = 44 sq. in. for 8-inch round hatch).
P_t = Absolute pressure inside the tank in inches of water
P_a = Absolute pressure outside the tank in inches of water

APPENDIX D—WALKWAYS, STAIRWAYS AND LADDERS

General

D.1

Walkways and stairways furnished to this specification shall be constructed from prefabricated components designed to be field erected alongside of tanks or similar structures. All material shall comply with the applicable parts of Section 2.

D.2

It should be noted that walkways, platforms and stairways or ladders are intended to provide access to devices on or near the deck within easy reach from the ladder or platform, and not for employee egress onto the deck itself. Where individuals are required to have access to the deck, suitable guard railings should be installed to prevent their falling.

Walkways

D.3

Walkway shall consist of tread (decking) sections, railing assemblies, and toeboards designed and assembled so that the completed structure will support a uniform load of 50 lb per sq ft, or a concentrated load of 1,000 lb at any place on the span without deflecting more than $^1/_{360}$ of the unsupported span length. The maximum span between tank brackets or ground supports shall be 25 feet. Where intermediate supports are required, the vertical members shall terminate at the top rail. The base for ground supports shall be of concrete or other suitable permanent foundation.

D.4 Treadway

Treadway shall be a minimum of 26 inches wide. Tread shall be uniformly perforated from the bottom with shaped punches to form a non-skid surface. Optionally, at the request of the purchaser, the deck of treadway sections may be fabricated from structural expanded metal or grating to avoid the build-up of snow or ice.

D.5 Railings

Railings shall consist of posts, horizontal braces, sway (truss) braces, gusset plates, toeboards, midrail and top rail. Railings shall be assembled so that the top rail is 42 inches above the treadway. The completed structure, when assembled, shall be capable of withstanding a concentrated force of 200 lb applied in any direction at any point on the top rail.

D.6 Toeboards

Toeboards shall be installed on all open sides (except at the entrance of stairways or ladders) to provide an installed height of 4 inches above the treadway.

D.7 Midrail

Midrail shall be installed approximately halfway between treadway and top rail. Where the midrail projects into a walkway area, the ends shall be formed to a smooth contour.

D.8 Brackets

Each tank shall be equipped with two bracket assemblies, securely bolted to the lugs specified in Fig. 1. The brackets shall be installed to provide a 26-inch wide access to the tank at the point of attachment.

Stairways

D.9

Stairways, when required for access to walkway sections, shall be designed for field erection, and shall be capable of supporting a minimum of 100 lb per linear foot of tread width, or a concentrated load of 1,000 lb at any point on the stairway without deflecting more than $^1/_{360}$ of the unsupported stairway length. Stairway width shall be a minimum of 26 inches. Stairways shall be designed and installed to have an angle of 45 degrees with the horizontal, unless otherwise specified by the purchaser. When installed at 45 degrees, the stairway shall have a run and rise of $8^1/_2$ inches with a nominal tread width of not less than 8 inches. Other uniform rise and tread combinations which will produce a stairway within angles to the horizontal between 30 and 50 degrees shall be acceptable, so long as all other requirements of this specification are met. The rise height and tread width shall be uniform throughout any stairway, including any foundation used as one or more steps.

D.10

Railings shall be installed on both sides of stairways, and shall be designed so that the completed assembly will withstand a minimum of 200 lb force in any direction applied at any point on the top rail. Top rails shall be installed so that the top rail is not less than 30 inches nor more than 34 inches measured vertically from the upper surface of the nose of a tread. Protection against falling shall be provided between the stairway runners and the top rail.

The juncture of the top rail of the stair railing shall make a smooth transition with the top rail of the walkway railing, preferably through the use of a structural gusset member.

D.11

Spiral stairways, attached to brackets on the circumference of the tank, may be used in lieu of straight stairways, provided all of the above requirements are met, with the exception that railings are required only on the outside of the stairway. The run of the stair tread will depend on the radius of the exterior arc, and the minimum effective tread shall be 7 inches, measured 13 inches from the exterior arc. Spiral stairways are not recommended for installation on tanks less than 15 feet, 6 inches in diameter.

Ladders

D.12

Fixed industrial ladders may be used in lieu of stairways. The use of a platform is optional with the purchaser, but when used, the platform shall have minimum dimensions of 26 inches x 30 inches with standard railings except at the entrance from the ladder.

D.13

Ladders, when used, shall be substantially anchored with the center of the rung at least 7 inches from the surface of the tank or other obstruction.

D.14

Rungs shall be a minimum of $^3/_4$ inch diameter, spaced a maximum of 12 inches center to center with a minimum clear length of 16 inches, and designed to support a minimum load of 200 lb.

D.15

Open ladders may be used to climb a maximum of 20 feet, and caged ladders or acceptable safety slide devices should be used when the climbing height is between 20 feet and 30 feet.

APPENDIX E—SUGGESTIONS FOR ORDERING

In placing orders for tanks to be manufactured in accordance with the stipulations of API Specification 12F, purchasers should specify the following on their purchase order:

Specification ..... API Specification 12F
Number of tanks .....
Nominal capacity ..... Table 1, Col. 1
Size ..... Par. 3.5
  Outside diameter ..... Table 1, Col. 4
  Height of shell ..... Table 1, Col. 5
Type of bottom ..... Par. 3.6
Shell plate thickness ..... Par. 3.10
Deck plate thickness ..... Par. 3.13
Delivery date and shipping instructions .....
Inspection by purchaser ..... Par. 7.2

The purchaser should also state on the purchase order his requirements concerning the following stipulations, which are optional with the purchaser:

Bolting ..... Par. 2.9
Viscous oil options ..... Table 1, footnote
Cleanout cover-plate design ..... Par. 3.16
Anti-channel drain baffle ..... Par. 3.18
Downcomer pipe and design ..... Par. 3.19
Walkways, stairways, and ladders ..... Appendix D

Attention is also called to the following stipulations, which are subject to agreement between the purchaser and the manufacturer:

Materials ..... Par. 2.1
Alternative bolting materials and/or finish ..... Par. 2.9
Additional connections ..... Par. 3.17
Finish coats of paint ..... Par. 5.4
Internal Coating ..... Par. 5.5

APPENDIX F—USE OF API MONOGRAM

The API monogram is a registered trademark of the American Petroleum Institute.

Manufacturers desiring to warrant that articles manufactured or sold by them conform with this specification shall obtain the license to use the Official API Monogram.

The original resolutions adopted by the Board of Directors of the American Petroleum Institute on Oct. 20, 1924, embodied the purpose and conditions under which such official monogram may be used.

The following restatement of the resolution was adopted by the Board of Directors on Nov. 14, 1977.

WHEREAS, The Board of Directors of the American Petroleum Institute has caused a review of the Institute's program for licensing the use of the API monogram and

WHEREAS, It now appears desirable to restate and clarify such licensing policy and to confirm and make explicitly clear that it is the licensees, not API, who make the representation and warranty that the equipment or material on which they have affixed the API monogram meets the applicable standards and specifications prescribed by the Institute;

NOW, THEREFORE, BE IT RESOLVED, That the purpose of the voluntary Standardization Program and the Monogram Program of the American Petroleum Institute is to establish a procedure by which purchasers of petroleum equipment and material may identify such equipment and materials as are represented and warranted by the manufacturers thereof to conform to applicable standards and specifications of the American Petroleum Institute; and be it further

RESOLVED, That the previous action under which the following monogram was adopted as the official monogram of the American Petroleum Institute is reaffirmed;

BE IT FURTHER RESOLVED, That the American Petroleum Institute's monogram and standardization programs have been beneficial to the general public as well as the petroleum industry and should be continued and the Secretary is hereby authorized to license the use of the monogram to anyone desiring to do so under such terms and conditions as may be authorized by the Board of Directors of the American Petroleum Institute, provided that the licensee shall agree that the use of the monogram by such licensee shall constitute the licensee's representation and warranty that equipment and materials bearing such monogram complies with the applicable standards and specifications of the American Petroleum Institute; and that licensee shall affix the monogram in the following manner;

BE IT FURTHER RESOLVED, That the words "Official Publication" shall be incorporated with said monogram on all such standards and specifications that may hereafter be adopted and published by the American Petroleum Institute, as follows:

OFFICIAL PUBLICATION

REG. U.S. PATENT OFFICE

F.1 API Monogram

The API monogram— —is a registered trademark/servicemark of the American Petroleum Institute. Authorization to use the monogram is granted by the Institute to qualified licensees for use as a warranty that they have obtained a valid license to use the monogram and that each individual item which bears the monogram conformed, in every detail, with the API Specification applicable at the time of manufacture. However, the American Petroleum Institute does not represent, warrant or guarantee that products bearing the API monogram do in fact conform to the applicable API standard or specification. Such authorization does not include use of the monogram on letterheads or in advertising without the express statement of fact describing the scope of licensee's authorization and further does not include use of the monogram, the name AMERICAN PETROLEUM INSTITUTE or the description "API" in any advertising or otherwise to indicate API approval or endorsement of products.

The formulation and publication of API Specifications and the API monogram program is not intended in any way to inhibit the purchase of products from companies not licensed to use the API monogram.

F.2 Application for Authority to Use Monogram

Manufacturers desiring to warrant that products manufactured by them comply with the requirements of a given API specification may apply for a license to use the monogram with forms provided in an appendix to each specification. Exhibit B is a typical "Statement of Manufacturer's Qualifi-

cations" and Exhibit C is a "License Agreement."

The "Agreement" form must be submitted in duplicate for each specification under which monogram rights are desired. One "Statement of Manufacturer's Qualifications" is required for each facility.

A manufacturer desiring to apply the monogram at more than one facility (a facility is any manufacturing location) must submit a separate application for each facility.

Applicants shall have an approved functioning quality program in conformance with API Specification Q1 prior to being issued a license to use the API monogram.

F.3 Authorization to Use the Monogram

A decision to guard or withhold monogram rights will be made by the staff of the Institute. A survey of the applicant's facilities will be made by an approved Institute surveyor prior to a decision to approve or withhold the license. The basis of the survey shall be the appropriate product Specification and all applicable portions of API Specification Q1.

For a manufacturer having more than one facility (plant), each facility will be judged separately and if determined to be eligible for authorization to use the monogram will be granted a separate license for each Specification, or part thereof, under which authorization is granted. The application of the monogram may not be subcontracted.

F.4 Fee for Use of Monogram

Initial Authorization Fee. The applicant will be invoiced an initial authorization fee for the first Specification included in the application, and a separate fee for each additional Specification included in the application. The applicant will also be invoiced for the surveyor's fee.

Annual Renewal Fee. In addition to the initial authorization fee, licensees will be assessed an annual renewal fee for each specification under which he is authorized to use the monogram. Applicants issued monogram certificates dated November 1 through December 31 shall not be required to pay a renewal fee for the following year.

The fees assessed are to defray the cost of the Monogram Program.

F.5 Periodic Survey

Existing licensees must be periodically surveyed by an approved Institute surveyor to determine whether or not they continue to qualify for authorization to use the monogram. The frequency of the periodic surveys will be at the discretion of the staff of the Institute. The surveyor's fee and expenses for making a periodic survey will be paid by the Institute.

F.6 Cancellation of Monogram Rights

The right to use the monogram is subject to cancellation for the following causes:

a. Applying the monogram on any product that does not meet the Specification.
b. Failure to maintain reference master gages in accordance with the Specifications.
c. Failure to meet the requirements of any resurvey.
d. Failure to pay the annual renewal fee for use of the monogram.
e. For any other reason satisfactory to the Executive Committee on Standardization of Oilfield Equipment and Materials.

F.7 Reinstatement of Monogram Rights

Manufacturers whose authorization to use the monogram has been cancelled may request reinstatement at any time. If a request for reinstatement is made within sixty (60) days after cancellation, and if the reason for cancellation has been corrected, no new application is necessary. A resurvey of the manufacturer's facilities will be made by an approved Institute surveyor prior to a decision to reinstate monogram rights. The manufacturer will be invoiced for this resurvey regardless of the Institute's decision on reinstatement. If the resurvey indicates that the manufacturer is qualified, the license will be reissued.

Request for reinstatement made more than sixty (60) days after cancellation shall be treated as a new application unless circumstances dictate an extension of this time period as agreed upon by the API staff.

F.8 Appeals

An interested party may appeal any API standards action. Appeals shall be directed to the Director, API Production Department and handled by the General Committee of the Production Department with a further right of appeal to the API Management Committee. Competing suppliers or manufacturers of the product or service to which the standard applies or might apply may not be involved in appeals. The General Committee and the Management Committee may convene appeals boards to hear and act on appeals.

F.9 Marking

The following marking requirements apply to licensed manufacturers using the API monogram on products covered by this specification.

F.10

Tanks manufactured in conformance with this specification shall be identified by a name plate bearing the information shown in Fig. E-1.

F.11

The name plate shall be stamped, etched or embossed on corrosion-resistant material and permanently attached to a bracket or backing plate of ferrous material. Alternatively, name plate information may be die stamped on a steel plate. The bracket, backing plate or name plate shall be seal-welded to the tank shell in the location shown in Fig. 1.

F.12 API Monogram

Tanks conforming to this specification shall be marked with the API monogram by manufacturers authorized to use the monogram. The monogram shall not be applied to tanks which do not conform to this specification, nor by manufacturers who have not been authorized to use the monogram.

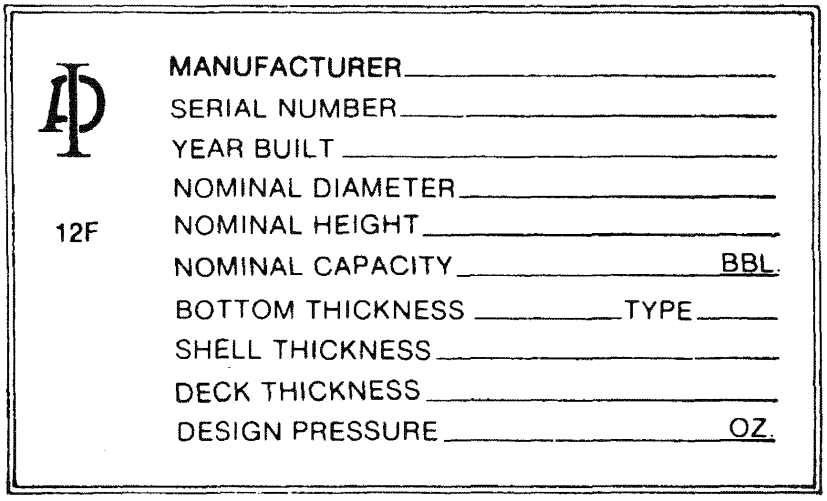

Figure F-1—Suggested Name Plate Format

CURRENT PUBLICATIONS OF THE AMERICAN PETROLEUM INSTITUTE PERTAINING TO STORAGE TANKS

API

RP 12R1 *Recommended Practice for Setting, Connecting, Maintenance and Operation of Lease Tanks*

A guide for new tank battery installations and a guide for revamping existing batteries if this is necessary for any reason.

RP 2003 *Protection Against Ignitions Arising Out of Static, Lightning and Stray Currents*

Described in this publication are some of the conditions which have resulted in oil fires ignited by the electrical sparks and arcs from so-called natural causes, as well as the methods which the petroleum industry currently is applying for the prevention of ignitions from these sources.

RP 2015 *Cleaning Petroleum Storage Tanks*

A discussion of safe practices in tank cleaning—including use of suitable mechanical equipment and protective clothing, use of proper cleaning methods, elimination of potential ignition hazards, and provision for means of entrance and exit in an emergency. Combines and updates information contained in *Accident Prevention Manual No. 1: Cleaning Petroleum Storage Tanks—Section A, Crude Oil and Unfinished Products Tanks* and *Bull. 2016: Cleaning Tanks Used for Gasoline or Similar Low-Flash Products.*

Spec 12B *Specification for Bolted Tanks for Storage of Production Liquids*

Covers material, design, fabrication, and testing requirements for vertical, cylindrical, above-ground, closed and open top, bolted steel storage tanks in nominal capacities of 100 to 10,000 bbl (in standard sizes). Also includes appurtenance requirements.

Spec 12D *Specification for Field Welded Tanks for Storage of Production Liquids*

Covers material, design, fabrication, and testing requirements for vertical cylindrical, above-ground, closed top, field welded steel storage tanks in nominal capacities of 500 to 10,000 bbl (in standard sizes).

Spec 12F *Specification for Shop Welded Tanks for Storage of Production Liquids*

Covers material, design, fabrication, and testing requirements for shop-fabricated vertical, cylindrical, aboveground, closed top, shop-welded steel storage tanks in nominal capacities of 90 to 500 bbl (in standard sizes).

Std 620 *Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks*

These rules cover the design and construction of large, welded, field-assembled storage tanks used for petroleum intermediates and finished products operated at a gas pressure of 15 psig and less, down to an internal gas pressure close to atmospheric pressure, which are not now provided for in API Standard 650.

Std 650 *Welded Steel Tanks for Oil Storage*

This standard covers material, design, fabrication, erection, and testing requirements for vertical, cylindrical, aboveground, closed- and open-top, welded steel storage tanks, in various sizes and capacities, for internal pressures approximating atmospheric pressures. It also includes an alternate basis for shell design, as well as one for calculating tank shell thickness.

Std 2000 *Venting Atmospheric and Low-Pressure Storage Tanks*

This standard applies to the normal and emergency venting requirements for aboveground liquid petroleum storage tanks and aboveground and belowground refrigerated storage tanks designed to operate from $^1/_2$ oz. per sq. in. vacuum through 15 psig pressure. The requirements of the standard do not apply to floating- or lifter-roof tanks.

Std 2550 *(ASTM D 1220-65)(75),† Measurement and Calibration of Upright Cylindrical Tanks, 1966 (ANSI Z11.197-1971) (Redesignated Chapter 2.2.2, API Manual of Petroleum Measurement Standards)*

This standard describes the procedures for calibrating upright cylindrical tanks larger than a barrel or drum. It is presented in two parts: Part I outlines procedures for making necessary measurements to determine total and incremental tank volumes. Part II presents the recommended procedure for computing volumes. Sample calculations are included in an appendix.

Std 2555 *(ASTM D 1406-65)(75),* Liquid Calibration of Tanks, 1966 (ANSI Z11.202-1971) (Redesignated Chapter 2.6, API Manual of Petroleum Measurement Standards)*

This standard describes the standard procedure for calibrating tanks, or portions of tanks, larger than a barrel or drum by introducing or withdrawing measured quanties of liquid.

Guide for Inspection of Refinery Equipment, Chapter XIII, Atmospheric and Low-Pressure Storage Tanks

This chapter covers the inspection of atmospheric storage tanks which have been designed to operate at pressures from atmospheric through 0.5 psig through, but not over, 15 psig. Such details as reasons for inspection, frequency and time of inspection, methods of inspection and of repair, and records are some of the principal items included.

†Joint standards for which API has prime responsibility.
*Joint standards for which ASTM has prime responsibility.